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Marshall Problem Statement / Senior Design Topic

Problem Title:	Solar System Communications Network
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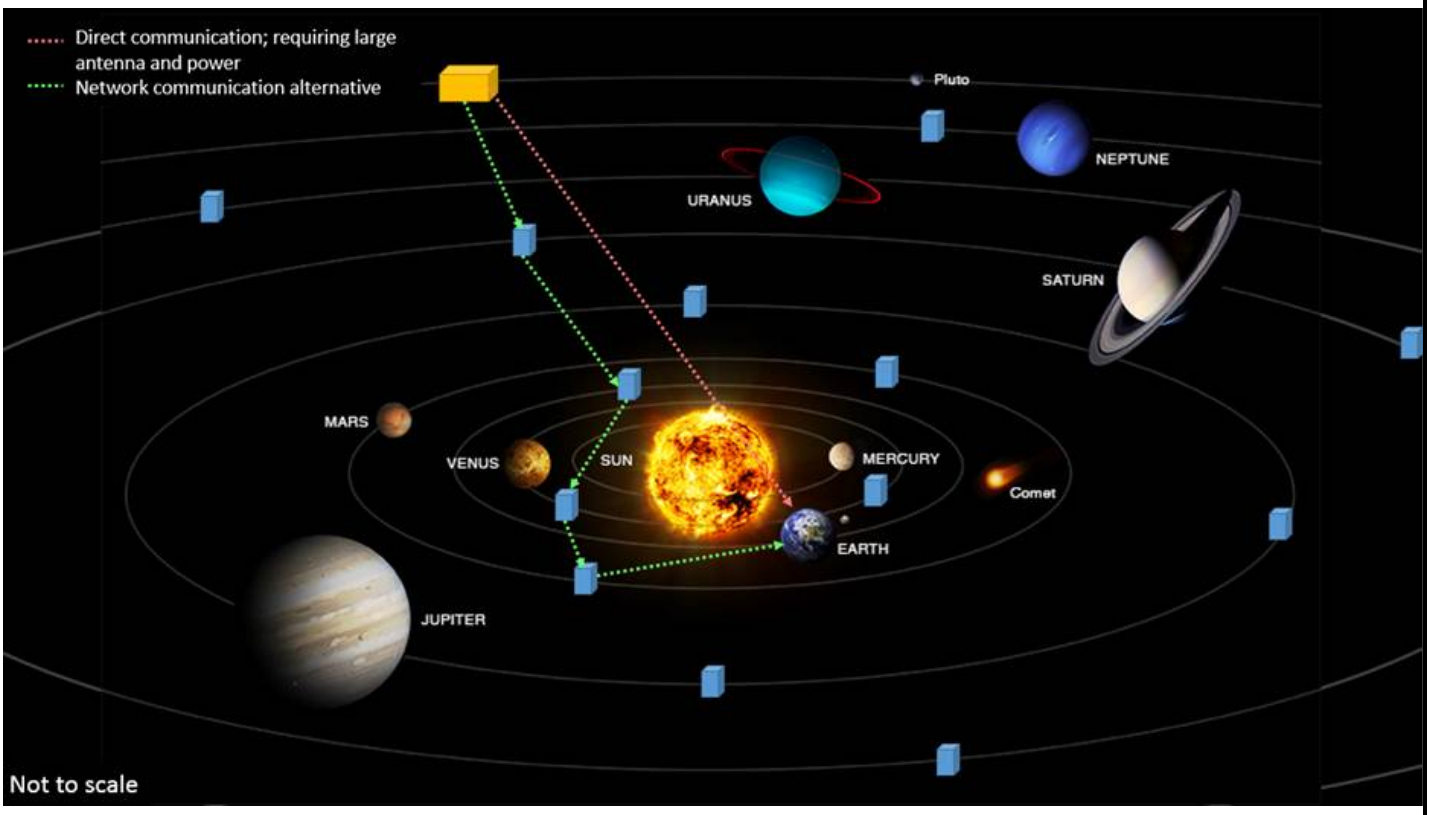
Indicate which discipline/s is/are most appropriate to work on this problem (e.g., aerospace, mechanical, electrical, chemical, industrial, civil, computer, physics, materials, test, nuclear, earth science, other):

Electrical, communications, computer, aerospace, project, and integration

Marshall Problem Statement

Background: The big picture with references to previous work
(Why would a senior design student be excited about this work?)

Design a communications network using a cluster of 6U cubesats that will enable future exploration satellites (or human missions) to reduce antenna power and gain, while improving link margin. Future satellites will no longer need to broadcast signal directly to earth, but rather to the nearest "solar cell tower". In doing so, exploration satellite power and antenna requirements can be reduced without jeopardizing the link margin or endangering the mission. In a hypothetical mission, the deep space satellite or capsule sends data to the nearest 6U cubesat which then relays the data to the next 6U cubesat. The relayed data would continue until it reaches earth.



Recent/on-going research on the problem (What resources, if any, are available to the senior design team, such as equipment, software, facility utilization)

Recent advances in delay tolerant (or disruption tolerant) network now permit incremental data packets to be sent across a series of nodes rather than joining all nodes to pass the entire data. Other solutions provide non-planar options but still requires all nodes to be connected (from start-to-finish) before data is transmitted.

Reference Links:
https://www.nasa.gov/content/dtn
http://www.nss.org/settlement/manufacturing/SM12.213.ContinuousInterPlanetaryCommunications.pdf

This design project is intended to produce a mission concept. No hardware production or testing is needed for this phase. Therefore, no resources are offered for this project.

Details of the problem; design constraints, requirements (if any), outcome expected (one semester Senior Design course lasts 15 weeks; two semester course lasts 30 weeks.) (What do you expect the senior design team to accomplish?)

Using 6U cubesats, design and develop a solar system (or interstellar) communication relay network. Each cubesat shall be able to receive and transmit data; survive in space environment for a minimum of fifteen years; determine its location within 10 meters; and perform orbital/trajectory maintenance.
Design solutions shall include power requirements and generation, suggested components and rationale for selected components, and any trade study analyses. Design solutions shall also include at least one comparison to existing mission capability (for example, New Horizons Probe transmission data rate and broadcast power requirement).
For the first 15 weeks, it can be assumed that the 6U CubeSats are already in desired location(s) and no orbital/trajectory maintenance is needed.
For the second 15 weeks, the mission concept shall expand upon methods for delivering the 6U CubeSats to desired location(s) or trajectory(ies) and orbit maintenance.

Senior Design Project Rules:

1. Weekly telecons will be scheduled to maintain proper progress and prevent dead-end ventures.
2. Deliverable/s required (e.g. one semester course – a written final report; two semester course – written final report and a prototype/model (if practical))